7. REVIEW OF SPIRAL AND BOUNDARY DATA

The work statement for this project did not include data analysis, but it did include a brief review of the data to suggest appropriate directions for future analyses. We have reviewed the ozone data collected by the Aztec during spirals to identify the locations and frequency of occurrence of elevated layers and to estimate the northern boundary concentrations on the first day of several episodes. The results of these reviews and some suggestions for future analyses are summarized in this section.

7.1 METHODOLOGY

The STI Aztec made 27 sampling flights from July through October 1997. Twenty-five of these were in the northern Los Angeles Basin and Mojave Desert. These flights were reviewed to identify ozone layers aloft. The morning Mojave Desert flights were also reviewed to determine the northern boundary conditions at the start of five episodes. Of the 25 flights, 11 flights were made in the early morning (from 0400 to 0900 PST) and 2 were made in the midmorning. The remaining 12 flights were made in the afternoon. Continuous ozone measurements were made during all flights, and the ozone data collected during the flight spirals were used to identify the presence of layers on different days and at different times of day. Ozone, NO_y, and NO_w data were reviewed to determine boundary conditions.

For each spiral, the ozone concentration at the lowest altitude of the spiral was determined. The altitude of the spiral low-point was then compared to the ground-level elevation to estimate whether the measurement was representative of conditions near the ground. Above the surface layer, additional layers were identified, and the maximum ozone concentration (averaged over about 50 m) in each layer was noted. For elevated layers, we also noted whether the layer was detached from the boundary layer, with cleaner air in between the layers. Peak ozone was recorded for layers that were characterized by reasonably constant concentrations, indicating well-mixed conditions, as well as for layers characterized by sharp ozone increases. This information was summarized in separate tables for the morning and afternoon flights. These tables are included in Appendix B.

For the morning boundary condition flights, the Desert spirals and constant-level traverses were reviewed to determine the boundary layer concentrations of ozone, NO_y, and NO_w, out of the influence of nearby surface emissions.

Summaries and simple analyses of the above information are included in the remainder of this section along with some suggestions for future analyses.

7.2 REVIEW OF LAYERS SEEN IN SPIRAL DATA

7.2.1 Early Morning Spirals

Early morning spirals at all basin sites were characterized by substantially depleted ozone at the surface, with carried-over ozone above up to the subsidence inversion. At these sites, there is often a near-surface layer where fresh emissions are trapped and ozone is essentially fully depleted, with various layering above the surface inversion up to the subsidence inversion. To estimate the importance of these carry-over layers, we examined the differences in concentration between the low-point of those spirals that went to the surface (generally within 20 m) and the peak concentration in those aloft layers below 800 m agl (roughly 2500 ft agl). We picked the 800 m agl cutoff arbitrarily as a level for which aloft species would most likely be entrained in the mixing layer by midday on most episode days. Thus, layers below 800 m agl would likely contribute to surface concentrations later in the day. The aloft-surface differences were averaged for each site. Similarly, the heights of the layer peaks in msl and agl were determined and averaged for each site. The raw data are included in Appendix B and summarized in **Table 7-1**.

An example spiral for El Monte for August 5, 1997 is shown in **Figure 7-1**. The depleted ozone layer near the surface is evident in this figure. The surface concentration was almost zero as expected from the high NO_y concentrations; and the peak below 800 m was about 67 ppb at about 525 m. In this figure, the top of the subsidence inversion was about 1000 m msl as seen from the temperature plot and the drop-off in aged NO_y concentrations. Thus, during the day, it is likely that the layers under this height will mix together as the surface heating drives mixing. This example also shows a detached layer of ozone above the subsidence inversion that represents carryover of aged pollutants from the day before. In this case the ozone peak at about 1350 m msl reached 120 ppb. These layers are discussed more in the next section. It is not clear whether the detached layer can contribute to surface concentrations through mixing to the surface.

From Table 7-1, it is clear that the peak concentrations aloft in the early morning are substantially higher than at the surface and will increase surface concentrations when mixed down. For all of the spirals in the Basin, the peak ozone concentrations in layers aloft averaged 48 ppb higher than the surface concentrations, which averaged 16 ppb over all Basin spiral sites listed in Table 7-1. The average aloft concentration (48 ppb + 16 ppb = 64 ppb) is higher than the clean-air ozone value of around 40 ppb, indicating carryover of ozone formed on prior days. However, this number is lower than we expected when compared to the comparable number for the Desert boundary conditions (see below) and with prior examples of carryover in the Basin. Since the aloft number is a peak number, the average concentration in the boundary layer will be even less. On some days, however, the concentrations carried over exceeded the 1-h federal standard, for example, the single Santa Barbara spiral in Table 7-1. For modeling purposes, it will be important to use the measured aloft initial conditions for the specific days of interest rather than the averages in Table 7-1. An estimate of the effect of the ozone aloft on surface concentrations could be obtained by integrating the early-morning ozone concentration through the boundary layer to get an idea of the concentration that would occur if the ozone in layers aloft were mixed to the surface.

Table 7-1. Early-morning spiral boundary-layer ozone peaks and differences from surface concentrations.

Location	Surface elevation (m)	Average ozone at spiral bottom* (ppb)	Average Difference between max ozone < 800 m agl and bottom of spiral* (ppb)	Average height of max ozone < 800 m agl (m msl)	Average height of max ozone < 800 m agl (m agl)	# spirals in average
Basin sites						
Camarillo	23	11	45	484	461	11
Offshore Malibu	0	25	37	511	511	7
Van Nuys	244	9	51	650	406	12
Santa Paula	75	24	54	425	350	1
Santa Barbara	3	38	90	500	497	1
El Monte	90	17	54	675	585	7
Ontario	287	3	68	875	588	6
Rialto	443	24	39	893	450	11
Riverside	249	19	42	785	536	10
Weighted average:		16	48		489	
Desert sites						
Agua Dulce	811	44	19	1135	324	5
Rosamond	736	37	22	950	214	5
Yucca Valley	983	40	15	1320	337	5
Banning	676	41	19	1085	409	5
Weighted average:		41	19		321	

*When bottom of spiral was near the surface over the runway.

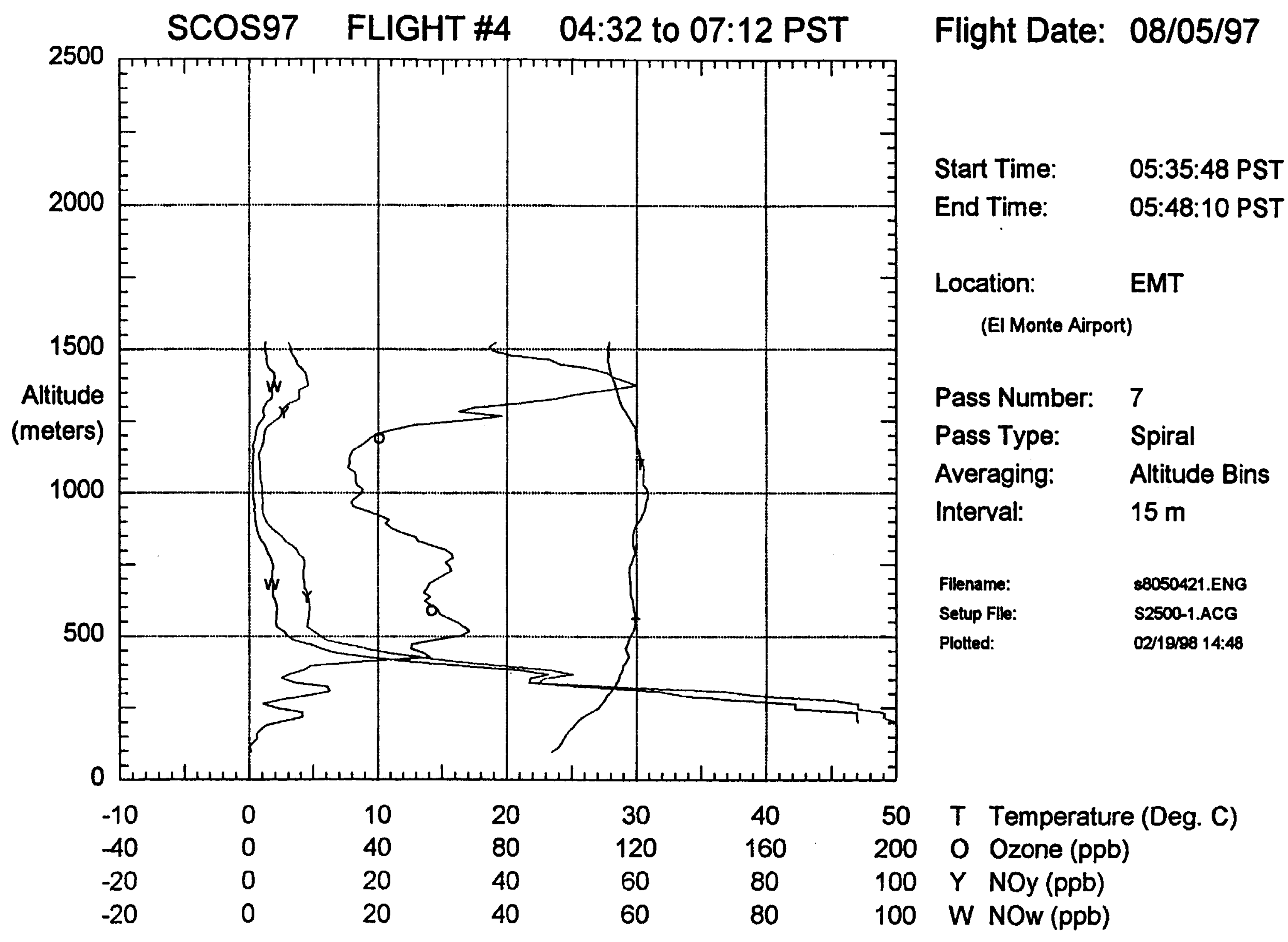

Figure 7-1. Morning spiral at El Monte airport on August 5, 1997.

The average height of the peaks in the upper layers in the Basin was 489 m agl, without much variability around that number. This height is typically at the top of the layer influenced by nighttime emissions, so the ozone at this level would not be depleted overnight.

In the Desert, there was much less depletion near the surface, but only a little less ozone left over aloft, at least on the first days of episodes when these flights were made. The average surface concentration was 41 ppb, with the peaks aloft averaging only 321 m above the surface and averaging only 19 ppb greater than the surface concentrations. The aloft average is 60 ppb (41 ppb + 19 ppb), which is only 4 ppb less than the comparable average for sites in the Basin on (mostly) episode days.

We also reviewed the morning spirals to examine the occurrence of detached layers that carry over above the boundary layer. These are discussed in Section 7.2.2. In addition, we examined the spirals near the coast on days when transport to Ventura was likely (Type 3 and 4 days using the SCOS97 episode classifications from Fujita et al., 1996). In the morning spirals, we did not find evidence of high concentration transport in low layers along the coast. We did see such layers in some afternoon spirals, which are discussed in Section 7.2.4.

7.2.2 Detached Layers

We also examined the morning and afternoon spirals to determine the occurrence of detached layers. These layers typically are above the polluted layer and usually above the subsidence inversion. They are separated from the boundary layer (or marine layer) by a layer of clean air. When viewed from the air they appear as a hazy layer separated from the haze below by a ribbon or layer of clear air. Ozone concentrations in these layers are typically 20-50 ppb greater than in the cleaner air below, but often similar to the same-day or previous-day mixing layer concentrations nearer to the surface.

Measuring these layers was one of the original reasons for our aircraft flights near the mountains, although this objective was eventually superseded. Detached layers can be formed by upslope flow and subsequent recirculation over the Basin or by wind shear that displaces a horizontal slice of the earlier mixing layer by a layer of cleaner air. The frequency of occurrence of these layers for morning and afternoon flights is shown in **Table 7-2**. This analysis was hampered somewhat for the afternoon flights because three of the afternoon flights during the seven "episode" days we flew were flown in the Desert, and one was flown in the Ventura County area. These days included four of the six highest concentration episodes. Since these layers are likely to be most important on or after high-concentration episodes, we may have missed some important examples. In addition, the aircraft only spiraled higher than 1500 m msl in the Basin at Rialto (afternoon only), Azusa, San Gabriel River Canyon, Van Nuys (afternoon), and Camarillo (afternoon); so we would have missed layers at other sites above that altitude.

Table 7-2. Detached layers observed during spirals in the STI Aztec.

Location	# of morning spirals with detached layers	% of morning spirals with detached layers	# of afternoon spirals with detached layers	% of afternoon spirals with detached layers
Basin sites				
Camarillo	2/13	15%	3/12	25%
Offshore Malibu	1/7	14%	0/3	0%
Simi Valley	1/1	100%	0/5	0%
Santa Paula	1/1	100%		
Santa Barbara	0/1	0%		
Van Nuys	2/13	15%	2/12	17%
El Monte	2/7	29%	1/8	13%
Azusa	1/6	17%	1/2	50%
San Gabriel Reservoir	3/6	50%		
Ontario	1/7	14%	1/8	13%
Rialto	0/12	0%	2/12	17%
Riverside	1/12	8%	3/11	27%
Total	15/86	17%	13/73	18%
Desert sites				
Agua Dulce	0/5	0%		
Bohunk's			0/4	0%
Rosamond	0/5	0%		
Hesperia	0/5	0%	0/4	0%
Yucca Valley	0/5	0%	0/4	0%
Banning	1/5	20%	0/4	0%
Total	1/25	4%	0/16	0%

From Table 7-2, it is clear that these layers are an infrequent occurrence, observed in less than 20% of both morning and afternoon spirals in the Basin and not observed in the Mojave Desert during our flights. When layers were observed in the morning, they tended to be widespread. Morning layers were seen on five days with layers seen at three to five sites on three of the days and at only one site on the other two days. The site where the most morning detached layers was seen was over the San Gabriel Reservoir. This would be expected since that site is in a mountain canyon and would be subject to upslope and downslope flow and wind shear. An example of a detached layer is seen in Figure 7-1. The dates and sites of the morning layers are:

8/4	Banning
8/5	El Monte, San Gabriel Reservoir, Van Nuys
8/7	Camarillo (two spirals), Malibu, Santa Paula, Simi, Van Nuys
8/23	Azusa, El Monte, Ontario, San Gabriel Reservoir, Riverside
9/29	San Gabriel Reservoir

Of these days, the layers seen exceeded 80 ppb on 8/5, 8/7, and 9/29, all of which followed episode (exceedance of the federal 1-h standard) days in the Basin.

The dates and locations of the afternoon layers were:

8/4	Ontario, Rialto, Riverside
8/5	Camarillo
8/22	Riverside, Van Nuys
8/23	Riverside
9/4	Van Nuys
9/5	Camarillo
9/29	Azusa
10/4	Camarillo, El Monte, Rialto

Of these days, layers exceeded 80 ppb on 8/4, 8/22, 9/4, and 10/4.

It is hard to draw conclusions from these data regarding the relationship between morning and afternoon layers or regarding spatial relationships because the flight plans were not repeated from morning to afternoon, and the spirals did not all go to the same height. From scanning the data, however, it appears that the classic detached layers that were above the mixed layer are unlikely to have much of an effect on surface concentrations, except possibly in the mountains where they might impinge directly. The layers were typically less than 250 m thick and were over 1000 m above ground. They were in stable air, and entrainment to the surface would be difficult. If they were somehow entrained, they would be diluted by at least a factor of four. The exceptions to this generalization were the layers seen on August 7 during the Ventura County flight. These are discussed in Section 7.2.3. Additional information on the sources and fate of these layers could be obtained from an analysis of the windfields and trajectories associated with the layers.

7.2.3 Special Morning Ventura County - Santa Barbara Flight on August 7

August 7, 1997 was a "Type 4" episode day, meaning a day of eddy transport to Ventura County following a South Coast Air Basin (SoCAB) episode. A midmorning flight was made on this day covering various western basin sites extending from Van Nuys to Malibu to Santa Barbara. Six of the seven spirals on this flight showed high concentration detached ozone layers peaking at 1000 to 1200 m msl. The layers were trapped below the subsidence inversion or in some cases extended across it with peaks above and below. The total depths of the multiple layers were about 500 m thick and were clearly carried over from the prior day at locations like Van Nuys and Malibu. In addition, the flight notes indicated a contribution aloft from fires in the mountains north of Santa Paula. The seventh spiral, at Santa Barbara, had similar multiple layers, but at a lower altitude, peaking at 500 to 800 m msl. The peak concentrations at Malibu, Santa Barbara, Santa Paula, and Van Nuys exceeded 120 ppb, and at the other sites exceeded 100 ppb. Since this was a Type 4 day, the layers were probably transported in part from the SoCAB from the prior day. This hypothesis can be tested by examining the windfield data for the study. Because of the widespread nature and large vertical extent of the layers and the fact that nearby mountains extend higher than the layers, it is possible that these layers contributed to surface concentrations later in the day, especially at inland and mountain locations where mixing could have brought the layers to the surface. This hypothesis can be tested further by using the available upper-air meteorological data to assess the transport and mixing of these layers later in the day. Examples of these layers can be seen in **Figures 7-2 and 7-3** which show the spiral data at Santa Paula and Santa Barbara, respectively.

7.2.4 Afternoon Flights

Several types of layering were seen in afternoon spirals. At El Monte, Ontario, Van Nuys, and the coastal sites, we frequently saw undercutting as described by Blumenthal et al. (1978). This undercutting is shown for El Monte on October 4, 1997 in **Figure 7-4**. The undercutting is characterized by depleted ozone near the surface in the marine layer, with higher concentrations of older ozone remaining aloft under the subsidence inversion, in this case peaking at about 120 ppb at about 800 m msl. At El Monte and the coastal locations, the undercutting is usually caused by the intrusion of the sea breeze, often with higher humidities near the surface. At Van Nuys, however, the surface undercut layer sometimes had lower humidity than above, and may have been caused by some other windshear phenomena. These surface layers at all sites generally had higher concentrations of NO/NO_y than the layers above, indicating a partial contribution to ozone depletion from NO scavenging.

Figure 7-4 also shows an afternoon example of a detached layer aloft over the lower inversion, but under another inversion apparent at the top of the spiral.

Another type of layer seen along the coast at Malibu and Camarillo was characterized by high concentrations of ozone at the top of the marine layer, with a sharp drop in dew point above the layer. An example is shown in **Figure 7-5** for Malibu on September 28. These layers were typically below 500 m msl and were at 200-300 m msl on the days with the highest concentrations. Afternoon flights were made at Malibu on September 28, September 29, and October 4. The peaks in these layers were 184 ppb at 150 m msl, 128 ppb at 300 m msl, and 74 ppb at 550 m msl, respectively. At Camarillo, afternoon spirals were made on all 12 flights. Concentrations in these low layers exceeded 100 ppb only on the same days as the Malibu flights. The heights of the layer peaks were 200 m msl, 200 m msl, and 550 m msl, respectively, or similar to the heights at Malibu. It is not clear if or where these layers are mixed to the surface as they are transported inland, but it is likely that they impact the coastal mountains which are substantially higher than the layers. Again, the fate of the layers could be assessed through analysis of the extensive windfields obtained during SCOS97.

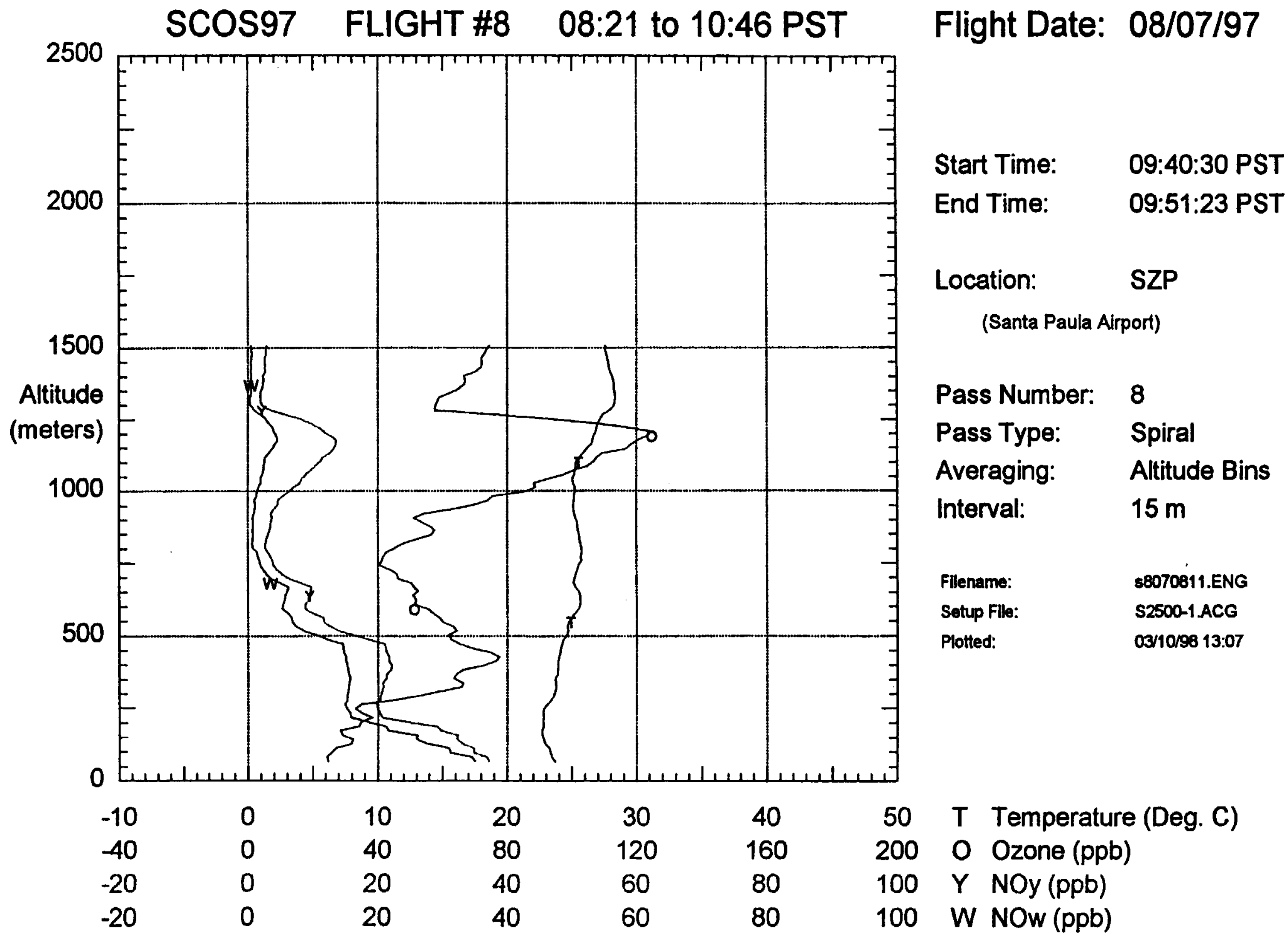

Figure 7-2. Morning spiral at Santa Paula airport on August 7, 1997.

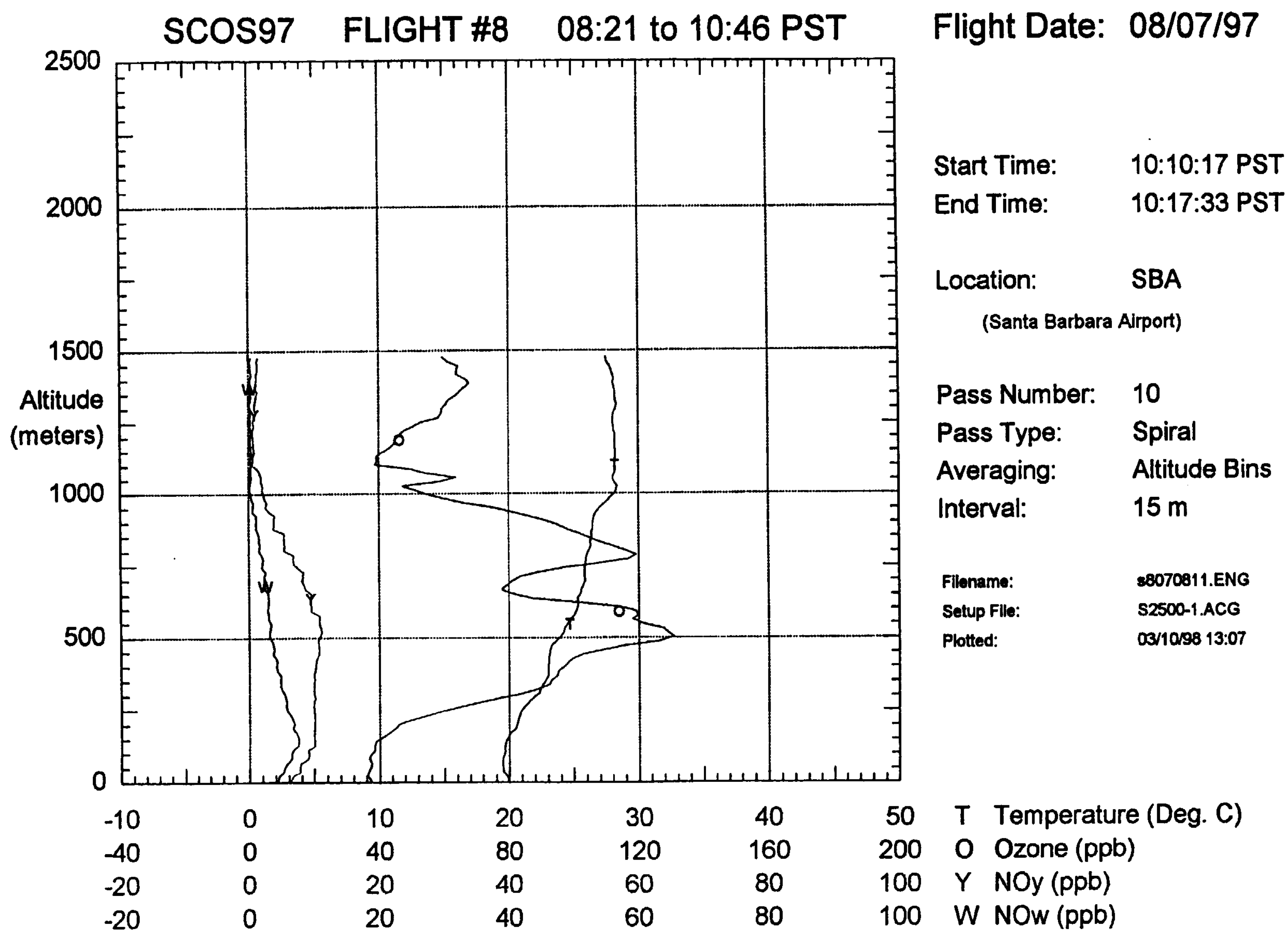

Figure 7-3. Morning spiral at Santa Barbara airport on August 7, 1997.

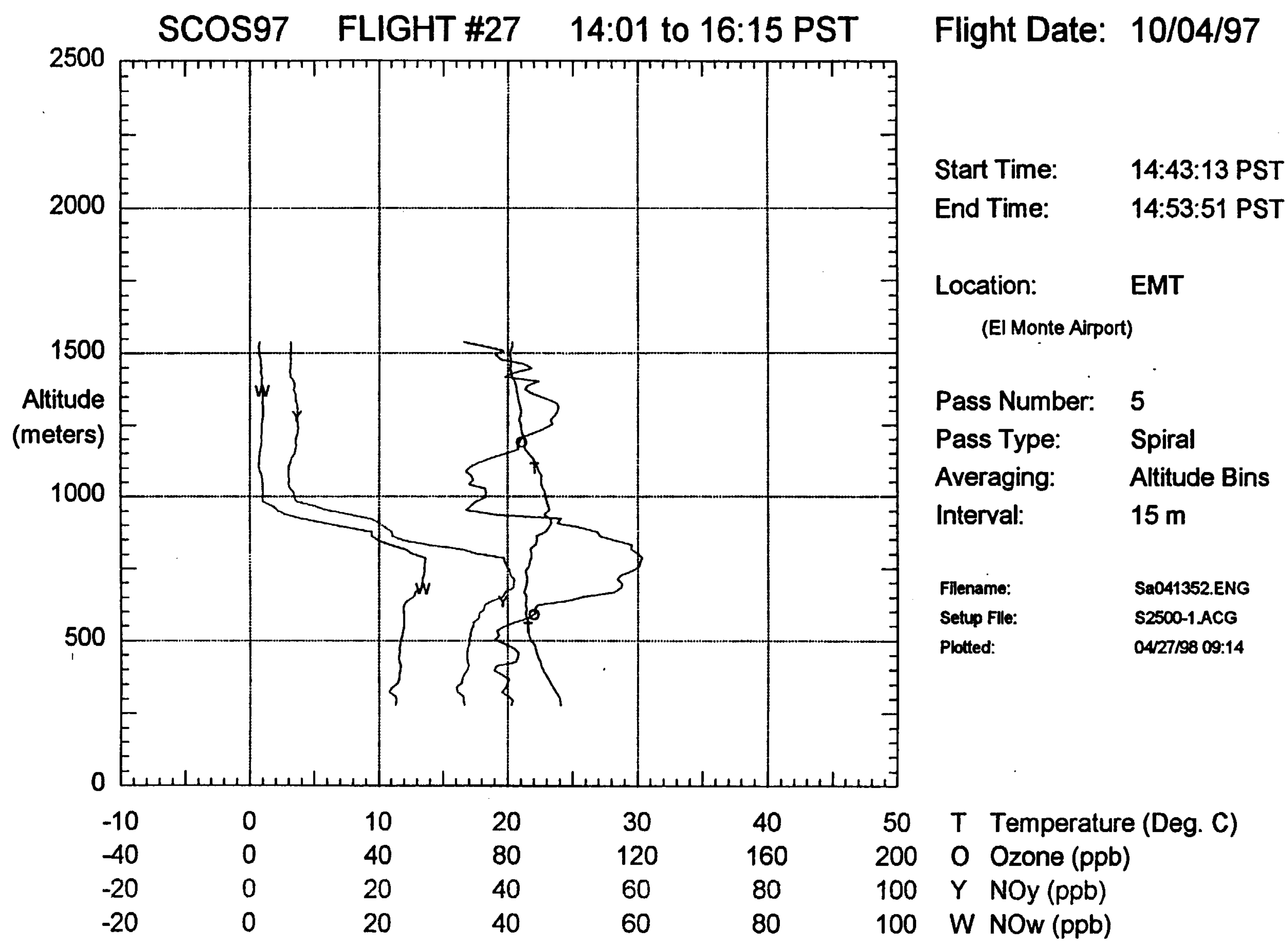

Figure 7-4. Afternoon spiral at El Monte airport on October 4, 1997.

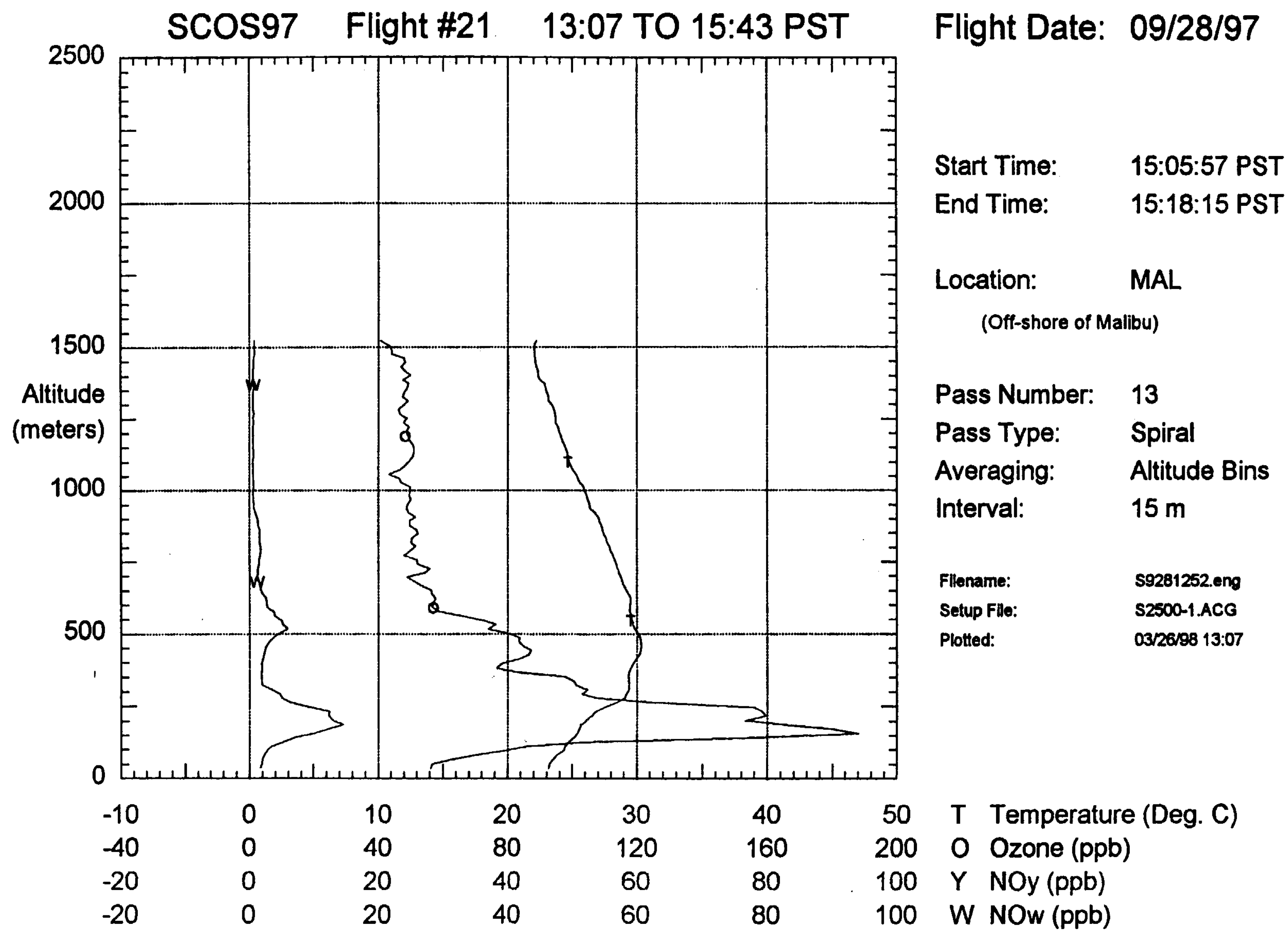

Figure 7-5. Afternoon spiral offshore of Malibu on September 28, 1997.

We also briefly looked at the spirals to examine transport to the desert during the four desert afternoon flights. Of these four days, only two days (August 6 and August 23) were Type 3 episode days during which transport to the desert would be expected. The spiral at Hesperia was designed to examine the flow through Cajon Pass, and the spiral at Bohunk's Airport was designed to see flow from Newhall Pass. On the non-Type 3 days, concentrations in these spirals did not exceed about 80 ppb. On August 6, the peak concentration in the spiral at Hesperia was 108 ppb and at Bohunk's was 140 ppb, with concentrations almost as high extending through the mixing layer. Clearly transport was contributing to concentrations exceeding the federal 1-h standard in the western Mojave desert on this day. On August 23, the peak at Hesperia was only 72 ppb at 1900 m msl, with concentrations in the low 60s below, indicating that Cajon Pass was not a major transport route at the time of the spiral. At Bohunk's, the peak in the mixing layer was 106 ppb, with slightly lower concentrations above and below. On this day, transport to the desert was not sufficient to cause the 1-h standard to be exceeded, but it might have contributed to exceedance of the new 8-h standard at some locations.

7.3 BOUNDARY CONDITIONS AT DESERT SITES

Five early morning flights were made in the desert on the first day of an episode to characterize the northern boundary. Spirals and traverses from desert locations during these flights were reviewed to assess the initial northern boundary conditions. The ozone, NO_y, and NO_w concentrations for the portions of these passes above the nearby surface emissions are summarized in **Table 7-3**. On the days sampled, the boundary ozone concentrations were typically in the 40-70 ppb range with occasional gradients of 10-20 ppb across the Desert with higher concentrations to the west.

The NO_y concentrations usually ranged from 2-4 ppb on these days. NO_w concentrations were typically about half the NO_y concentrations. Except near the surface, we assume that little of the NO_y is NO_2, so the other half may be nitric acid, PAN, and other nitrates. These levels of ozone and NO_y indicate that the boundary air is not "clean air", although it has concentrations substantially lower than those seen in the Basin.

Even in the Desert, in the early morning, the NO and NO_y often spiked near the surface, indicating local emissions.

Table 7-3. Boundary conditions in boundary layer above surface emissions during morning desert flights.

Location & Date	Spiral/Traverse	Ozone* (ppb)	NOy* (ppb)	NOw* (ppb)	Comments
August 4					
Agua Dulce	spiral	50	1-3	0.5-2	
Rosamond	spiral	70	2-3	1-2	
Rosamond-Hesperia	traverse	50-70	2-4	1-2	higher concentrations from midpoint to HES
Hesperia	spiral	60	2-3	0-1	higher concentrations near surface
Cajon-Soggy Lake	traverse	50-70	4	2	
Yucca Valley	spiral	70	2-3	0.5-1	
Banning	spiral	60-70	2	1	
August 22					
Agua Dulce	spiral	50	1	0.5	
Rosamond	spiral	50-60	0-1	0-0.5	
Rosamond-Hesperia	traverse	55-65	2	1	ozone dropped to about 35 ppb near HES
Hesperia	spiral	35	3	2	
Cajon-Soggy Lake	traverse	40	2	1	
Yucca Valley	spiral	35	2	1	ozone was about 50 ppb above 1500 m msl
Banning	spiral	45	1-2	0.5-1	ozone dropped to 40 ppb above 1400 m msl
September 4					
Agua Dulce	spiral	50-70	4-5	2	ozone jumped to 70 ppb above 1300 m msl
Rosamond	spiral	50-60	2	1-2	ozone higher, NOw lower at top of spiral
Rosamond-Hesperia	traverse	50	1.5-4	0.5-1	NOy, NOw concentrations jump half way to HES
Hesperia	spiral	50-65	2-4	0-.5	ozone and NOy increased with altitude
Cajon-Soggy Lake	traverse	50	4-2	1-0	higher NOy, NOw concentrations were near Cajon
Yucca Valley	spiral	50	1-2	0-1	higher concentrations were below 1450 m msl
Banning	spiral	50	1	0	
September 5					
Agua Dulce	spiral	80	6	2	top of mixing layer is about 1250 m msl, lower conc. above
Rosamond	spiral	70	4	1	
Rosamond-Hesperia	traverse	70-60	4-5	1-2	concentrations dropped to lower numbers near HES
Hesperia	spiral	55-60	4	1	ozone dropped to 30 ppb above 1600 m msl

Table 7-3. Boundary conditions in boundary layer above surface emissions during morning desert flights.

Location & Date	Spiral/Traverse	Ozone* (ppb)	NOy* (ppb)	NOw* (ppb)	Comments
Cajon-Soggy Lake	traverse	60-80	4-5	1-2	highest concentrations in middle of traverse
Yucca Valley	spiral	60	3	1	
Banning	spiral	40-60	2	0	ozone dropped to 40 ppb above 1000 m msl
October 3					
Agua Dulce	spiral	30-50	2-7	1-4	ozone increased; NOy, NOw decreased with altitude with jump at about 1100 m msl
Rosamond	spiral	44	2	0-0.5	
Rosamond-Hesperia	traverse	45	3	1	
Hesperia	spiral	45	1	0	
Cajon-Soggy Lake	traverse	45	2	1	
Yucca Valley	spiral	40-50	2-1	1-0	ozone increased, NOy, NOw decreased with altitude above surface layer
Banning	spiral	44	1-2	0-1	NOy to 25 ppb in sfc layer, ozone jumped to 64 ppb at 2400 m msl

*concentrations given are approximate numbers outside the influence of near surface emissions.
NOw is a measurement of NOy with the nitric acid and particle nitrate filtered out.

7.4 SUGGESTIONS FOR ADDITIONAL ANALYSES

The analyses that can be performed with the aircraft data alone are limited, but many useful analyses can be envisioned by combining the full range of SCOS97 data available. The aircraft provide point measurements in time and space; but the widespread, continuous upper-air meteorological measurements provide a means to assess the source and fate of pollutant concentrations seen in the aircraft data. The measurements by multiple aircraft and the lidar provide a means to extend the few STI spiral measurements at a given location and further assess the formation mechanisms for layers seen, especially at El Monte.

Some specific analyses of the source and fate of ozone layers that can be performed with SCOS97 data include:

- Combining aircraft data with wind data to analyze the formation mechanisms for the detached layers seen near the mountains. The upper-air wind data can be used to perform forward and back trajectory analyses of the layers and surrounding air.

- Using meteorological data and trajectory/dispersion analyses to determine the source and fate of the high-concentration layers at the shoreline below 500 m. Forward and back trajectory analyses can be performed. The layers can be used as a source for Monte-Carlo-type multi-particle analyses to see where the ozone ends up.

- Using meteorological data as above to analyze the fate of aloft ozone on August 7. The evolution of the mixing layer can be assessed from the radar profiler and rawinsonde data, and the contribution to surface concentrations can be estimated by examining where the layers were likely to be by midday and estimating a mixed layer integral assuming the layers under the mixed layer were mixed to the surface.

- Using continuous lidar data, radar profiler data, and aircraft spirals from multiple aircraft to analyze in detail the undercutting mechanisms and formation of elevated layers at El Monte.

Using simple analyses and more-sophisticated modeling, the aircraft data can be used to estimate the effect of the carry-over aloft ozone on surface concentrations. Such an estimate could be obtained by integrating the early-morning ozone concentration up to the midday and afternoon mixing heights to get an idea of the surface concentrations that would occur if the aloft ozone were mixed to the surface. To do this the midday and afternoon mixing need to be calculated from the various aircraft data and from the upper-air meteorological data. The transport of the layers aloft could be estimated to find the midday and afternoon locations where the layers might affect surface concentrations and to find the proper mixing height to use in the calculation. A more refined way to perform such an analysis is to run a three-dimensional photochemical grid model with and without the measured initial carryover to assess the effect of carryover on surface concentrations.

8. REFERENCES

Anderson J.A., Koos J.C., and Hammarstrand R.G.M. (1989) Summary of SCAQS upper air measurements performed by the STI aircraft. Report prepared for California Air Resources Board, Sacramento, CA by Sonoma Technology, Inc., Santa Rosa, CA, STI-97010-902-FR, Contract No. A6-098-32, April.

Anderson J.A., Hansen P.W., Prouty J.D., and Gardner J.M. (1993) Data collected by the STI aircraft during the 1992 ARB Southern California Transport Asessment Study. Data volume prepared for the California Air Resources Board, Sacramento, CA by Sonoma Technology, Inc., Santa Rosa, CA and Mercado-Gardner, Cloverdale, CA, STI-92120-1238-DV, January.

Anderson J.A., Wright D.B., and Blumenthal D.L. (1998) The real-time measurement data collected aboard the STI aircraft during SCOS97 sampling. Data volume prepared for the California Air Resources Board, Sacramento, CA, STI-997190-1807-DV, May.

Blumenthal D.L. and Ogren J.A. (1976) Pollutant characterization over ocean during offshore flow regime. Preliminary report prepared for California Air Resources Board, Sacramento, CA by Meteorology Research, Inc., Altadena, CA, MRI 76 R-1460, Contract No. A5-064-87, October.

Blumenthal D.L., White W.H., and Smith T.B. (1978) Anatomy of a Los Angeles smog episode: pollutant transport in the daytime sea breeze regime. *Atmos. Environ.* **12**, 893-907.

Blumenthal D.L., Smith T.B., and White W.H. (1980) The Evolution of the 3-D Distribution of Air Pollutants During a Los Angeles Smog Episode: July 24-26, 1973. In *The Character and Origins of Smog Aerosols. A Digest of Results from the California Aerosol Characterization Experiment (ACHEX)*, Vol. 9, Hidy G.M., Mueller P.K., Grosjean D., Appel B.R., and Wesolowski J.J., eds., John-Wiley & Sons, New York, pp. 613-650.

Blumenthal D.L., Smith T.B., Lehrman D.E., Alexander N.L., Lurmann F., and Godden D. (1986) Analysis of aerometric and meteorological data for the Ventura County Region. Final report prepared for the Western Oil and Gas Association (WOGA), Los Angeles, CA by Sonoma Technology, Inc., Santa Rosa, CA and Environmental Research & Technology, Inc., Newbury Park, CA, STI-90094-511-FR, Contract No. 83-8.0.05(3)-14-01-SOT.

Bumiller K. (1998) University of California, Riverside, College of Engineering, Center for Environmental Research & Technology (CE-CERT), Riverside, CA. Personal communication.

Carroll J.J. and Dixon A.J. (1997) Aircraft measurements in support of the NOAA 2-D lidar demonstration. Final report prepared for the California Air Resources Board, Sacramento, CA by the University of California, Davis, Department of Land, Air and Water Resources, Davis, CA, March.

Fujita E.M., Green M.C., Keislar R.E., Koracin D.R., Moosmuller H., and Watson J.G. (1996) 1997 Southern California Ozone Study (SCOS97) field study plan. Draft report prepared for California Air Resources Board, Sacramento, CA by Desert Research Institute, Reno, NV and The 1997 Southern California Ozone Study (SCOS97) Technical Committee and Working Groups, Contract No. 93-326, June.

Fujita E.M., Moosmuller H., Green M., Bowen J., Rogers F., Dolislager L., Lashgari A., Motallebi N., Pasek R., and Pederson J. (1998) SCOS97-NARSTO, 1997 Southern California Ozone Study and Aerosol Study, Volume IV: Summary of Quality Assurance. Report prepared for California Air Resources Board, Sacramento, CA by Desert Research Institute, Reno, NV, Research Division, California Air Resources Board, and the 1997 Southern California Ozone Study (SCOS97) Technical Committee and Working Groups, April.

Keifer W.S., Muller S.A., Jahnsen L.J., Blumenthal D.L., and Knuth W.R. (1979) Three-dimensional characterization of surface and subsidence layers in coastal and inalnd valleys - summer 1978. Data volume prepared for Southern California Edison Company by Meteorology Research, Inc., Santa Rosa, CA, MRI 79 DV-1662, Contract B212-8903.

Main H.H., Roberts P.T., Anderson J.A., and Fung K. (1991) Pollutant concentrations along the western boundary of the South Coast Air Basin part II: analysis of June 1990 data collected offshore. Final report prepared for the South Coast Air Quality Management District, Diamond Bar, CA by Sonoma Technology, Inc., Santa Rosa, CA, STI-90080-1149-FR, July.

Main H.H., Korc M.E., Roberts P.T., Lester J., and Hogo H. (1993) Comparison of 3-D air quality data with UAM sensitivity runs for the South Coast Air Basin. Paper M8II.4 presented at the *Air & Waste Management Association Regional Photochemical Measurement and Modeling Studies Conference, San Diego, CA, November 8-12*, (STI-1383).

McElroy J.L. and Smith T.B. (1993) Creation and fate of ozone layers aloft in Southern California. *Atmos. Environ.* **27A**, 1917-1929.

Miguel M. (1999) Quality assurance report. Prepared by the Quality Assurance Section, Monitoring and Laboratory Division, California Air Resources Board, Sacramento, CA, January.

Roberts P.T. and Main H.H. (1992) Characterization of three-dimensional air quality during the SCAQS. In *Southern California Air Quality Study Data Analysis. Proceedings from the SCAQS Data Analysis Conference, University of California, Los Angeles, CA, July 21-23*, Air & Waste Management Association, Pittsburgh, PA, (STI-1223), VIP-26.

Roberts P.T., Main H.H., Lindsey C.G., and Korc M.E. (1993) Ozone and particulate matter case study analysis for the Southern California Air Quality Study. Final report prepared for California Air Resources Board, Sacramento, CA by Sonoma Technology, Inc., Santa Rosa, CA, STI-90020-1222-FR, Contract No. A932-050, May.

Smith T.B., Saunders W.D., and Shair F.H. (1983) Analysis of Santa Barbara Oxidant Study. Report prepared for California Air Resources Board, Sacramento, CA by Meteorology Research, Inc., Altadena, CA and California Institute of Technology, Pasadena, CA, MRI FR - 1900, Contract No. A2-086-32, December.

Smith T.B., Lehrman D.E., Knuth W.R., and Johnson D. (1997) Monitoring in ozone transport corridors. Final report prepared for the California Air Resources Board, Sacramento, CA by Technical & Business Systems, Inc., Santa Rosa, CA and Ogden Environmental and Energy Services, Boulder, CO, July.

Watson J. and Warren M. (1997) Preliminary performance audit. Prepared by the Quality Assurance Section, Monitoring and Laboratory Division, California Air Resources Board, Sacramento, CA, June.

APPENDIX A

THE SCOS97 AIRCRAFT SAMPLING PROGRAM CHECKLIST USED BY THE STI FLIGHT CREW

SCOS97
AIRCRAFT SAMPLING PROGRAM

PREFLIGHT CHECKLIST AND FLIGHT PROCEDURES FOR AZTEC N6670Y

I. START OF PROJECT

1. CABLES, TUBES, FITTINGS, ETC.:

A. Inspect general condition OK

2. EXTERIOR SAMPLE INLET TUBES:

A. Cap or plug

3. STI POWER SWITCH
(Silver toggle switch on the pilot's instrument panel):

A. Switch "OFF" (Down)

4. INSTRUMENT RACK TOGGLE SWITCHES:

A. Inverter #1: Switch "OFF" (Down)
B. Inverter #2: Switch "OFF" (Down)

5. INSTRUMENT RACK BREAKER SWITCHES:

A. Pull "OUT"

6. PROJECT EQUIPMENT POWER:

A. Switches "OFF" (Down)

7. SHORE POWER CORD (115V-60Hz):

A. Connect to the "Hubbel" power connector located inside the baggage door of the aircraft (aft rack near the floor)

8. DEW POINT HYGROMETER:

A. Function Switch: "OFF"

9. AIRBORNE INSTRUMENT PACKAGE (AIP):

A. Power: Turn "ON" (UP). No light at this time.
B. All switches: Turn Full "CCW" (Counterclockwise)

C. AIP Breaker Switch: Push "IN"

10. NO/NO_y MONITOR (TECO Model 42S):

A. Desiccant: Check color and replace if necessary. Mount desiccant container vertically, with screw on cap and inlet on the bottom and suction to instrument on top.

B. Charcoal Filter: Connected to instrument exhaust

C. Front Panel Settings:

1. Temperature: 350° Celsius
2. Power: Turn "ON"
3. Ozone Lamp: Turn "ON"
4. PMT: Turn "ON"
5. RUN/TEST: Turn "ON"
6. Chamber Vacuum: 25 - 27 inches Hg.
7. LED Readout: Displays greeting then indicates NO/NO_x values
8. STAT Switch: Press repeatedly to display the following:

    a. F Scale
    b. NO Range
    c. NO_x Range
    d Troubleshooting Parameters

CL:	Cooler Temperature (~ -10°)
CT:	Converter Temperature (~ 350°)
RC:	Reaction Chamber (~ 49.5°)
B1:	NO Zero.
B3:	NO_y Zero.
SF:	NO Span Factor
BF:	NO_y Span Factor
CE:	Converter Efficiency (~99.7%)
NR:	Number Register - Ignore
O:	Offset - Leave at 0.0
DIP:	Dip Switch. 2, 4, 6, and 8 "ON"
P:	Software Version Number. Record this in equipment log during calibrations.
PT:	Pressure and Temperature. Reads "ON"
°C:	Temperature inside unit. Should be <40°C.
FSCALE:	End of Troubleshooting mode.

9. Z/FS Button: Pressing Z/FS displays a 0 first, then -.23 volts.

The display then scrolls up and can be stopped at any displayed voltage so that DAS readouts can be checked. To stop the displayed voltage, press the Z/FS switch a second time.

10. REMOTE, ENT, and CAL Buttons: Disabled.

11. RUN Button: Press to activate. This is the normal operating mode as well as the instrument default mode. All diagnostics are canceled and the instrument is placed in automatic sampling mode. Display shows NO, Pressure, or NO_x as chosen by the DISP button.

12. DISP Button: Press to change displayed sample values. NO concentration is indicated by a number "1" followed by the current concentration. Pressure is indicated by the value following number "2" and NO_x concentration follows number "3".

11. NO_w MONITOR (TECO Model 42S):

A. Repeat steps 1-12 as listed under the NO_y instrument.

12. OZONE MONITOR (ML8410):

A. Power Switch: Turn "OFF"
B. Gas Regulator: "CLOSE" [the second stage of] the regulator by turning the regulator handle counter-clockwise (until minimal resistance is felt). "CLOSE" the Supply valve (on the regulator).
C. C_2H_4 Bottle Valve: Turn "OPEN"
D. Gas Regulator: Set the "low pressure" regulator gage reading to 45 psi by turning the regulator handle clockwise. "OPEN" the supply valve.
E. C_2H_4 Bottle Valve: Turn "CLOSED"
F. Regulator: Watch for pressure drop indicating a C_2H_4 leak.
G. C_2H_4 Bottle: Turn "OPEN"
H. C_2H_4 Connections: Use "Snoop" to test for leaks.
I. C_2H_4 Bottle and Supply Valves: Turn "CLOSED"
J. Power Switch: Turn "ON"
K. Range Switch: Select "Range 2" (500 ppb)
L. Time Constant: Select "5 Seconds"
M. Sample Flow: Adjust to 300 cc/min
N. Function Switch: Select "Monitor"
O. Sample Tube: Confirm that the sample inlet is securely connected to the glass manifold.

P. Exhaust Tube: Confirm that the exhaust is securely connected to the exhaust manifold.

13. JUNCTION BOX:

A. Verify that all sockets have signal connectors (or shorting connectors) attached.

B. Connect desired signal inputs to the strip-chart recorder.

14. DATA ACQUISITION SYSTEM:

A.	System Power:	Turn "ON".
B.	Monitor Screen:	After cycling through several self-tests the screen will display the main screen.

15. PRINTER:

A.	POWER LED:	Confirm that power came on with the rest of the DAS and that the POWER LED is illuminated
B.	ON LINE LED:	Confirm that the ON LINE LED is illuminated.
C.	Paper Supply:	If less than 1/4 inch of thermal paper remains on the roll, the roll must be replaced.

16. HYDROCARBON SYSTEM:

A. Confirm inlet line capped

B. Confirm purge "T" capped

17. AIRCRAFT WALK-AROUND:

A.	Pitot Tube:	Check that inlet to is free of obstructions, then cover.
B.	Turbulence Probe:	Check that inlet is free of obstructions.
C.	Temperature Probes:	Check that the vortex housings of both temperature probes are free of obstructions.
D.	Dew Point Sensor:	Check that dew point sensor head is free of obstructions.
E.	Exhaust Outlet:	Check that exhaust outlet is free of obstructions.

II. ONE HOUR BEFORE TAXIING

1. EXTERNAL CHECKS:

A. Remove all pitot covers.
B. Confirm that the ROG and carbonyl inlet lines are capped.
C. Confirm that all other inlet lines are free of obstructions.
D. Inspect the AIP temperature sensor and its vortex housing for obstructions.
E. Inspect the dew point sensor inlet and exhaust free of obstructions.
F. Inspect the sampling instrumentation "EXHAUST OUTLET" free of obstructions.
G. Inspect the Rosemont temperature probe free of obstructions
H. Inspect the turbulence probe free of obstructions.

2. RECORD AIRCRAFT FLIGHT TIMES:

A. Record aircraft Hobbs times in flight log

3. DATA ACQUISITION SYSTEM

A. DAS Power: Confirm power "ON" and DAS operating in data acquisition mode.
B. ZIP drive disks: Label on extra disk as follows:

1. Project Name
2. Date

C. Place emergency disk in drive"A", **but do not insert all the way.**
D. Make sure ZIP disk is in drive and drive-light is green.
E. Emergency Disks: Confirm that at least <u>two</u> additional 3.5" emergency boot/data disks are aboard and <u>readily accessible.</u>
F. Press **SHIFT-F5** to enter DAS Setup Menu
G. Time and Date are displayed on the monitor

1. If changes to either time or date are required, select "T" or "D" and make corrections
2. If no changes are required, press <ENTER>, then <**X**> for the system to reboot and display the DAS program main screen

H. Printer Paper: If less than 1/4 inch of paper remains on the roll, the roll must be replaced.

I. Confirm that Printer is "ON" and "ON LINE"

J. Record the following on the Systems check sheet:

1. DAS serial number
2. DAS display time in "DAS" block
3. Watch time in "Watch Time" block

4. SYSTEMS CHECK SHEET:

A. Fill in the appropriate blocks of the *Flight Information* section of the AIRCRAFT SYSTEMS CHECK SHEET:

1. Date
2. Time
3. Location
4. Flight #
5. Operator Name
6. Altimeter setting - from ATIS
7. Observed weather (visibility, ceiling, winds, temp, dewpoint) - from ATIS

FILL IN THE *INSTRUMENT INFORMATION* SECTION OF *THE AIRCRAFT SYSTEMS CHECK SHEET* WHILE CHECKING THE FOLLOWING INSTRUMENTS. INCLUDE CROSS CHECK VALUES WHEN POSSIBLE.

5. DEW POINT HYGROMETER:

A. Function Switch: Select "TEST" (Do not keep in TEST mode for more than one minute)
C. Balance Control: Adjust for a centerline meter reading
D. Function Switch: Select "OPERATE"
E. Record Channel 3 DAS value on check sheet
F. Record front panel meter reading (% of full scale) of dewpoint signal conditioning unit on check sheet

6. OZONE MONITOR (ML8410):

A. Record Ozone analyzer serial number on check sheet
B. C_2H_4 Bottle Valve: "OPEN"
C. Record high and low pressure gage readings on check sheet
D. "Snoop" ethylene connections.
E. C_2H_4 Bottle Valve: "CLOSED"
F. Watch high pressure side of regulator for a pressure drop (indicating a leak)

G. C_2H_4 <u>Bottle Valve</u>: "OPEN"
H. C_2H_4 <u>Supply Valve</u>: "OPEN"
I. C_2H_4 Regulator: Adjust to ~35 PSI.
J. Ethylene Flow: Verify or set to ~30cc
K. Rotometers: Record Sample and Ethylene flows on the check sheet
L. Function: Select "ELECT TEST" (front panel meter and DAS display should indicate greater than 1/2 scale and about 2.500 volts respectively)
M. Function: Select "OPTIC TEST" (front panel meter and DAS display should indicate greater than full scale and about 6.890 volts respectively)
N. Function: Select "MONITOR"
O. Record Channel 5 DAS O_3 reading in the DAS column of check sheet
P. Record O_3 monitor front panel meter reading in the instrument column
Q. Record Span Pot setting on the check sheet
R. Range Switch: Verify or select "RANGE 2" (500 ppb)
S. Time Constant: Verify of select "5 SEC"
T. Record Range Switch setting on the check sheet
U. Record Time Constant setting on the check sheet
W. C_2H_4 <u>Supply Valve</u>: "CLOSED"

7. NO/NO_y MONITOR (TECO Model 42S):

A. Record NO/NO_y Analyzer serial number on check sheet
B. Verify Front Panel Settings:

1. Temperature: 350° Celsius
2. Power: "ON"
3. LED Display: Displaying NO/NO_y readings
4. Ozonator Lamp: Turn "ON"
5. PMT: Turn "ON"
6. RUN/TEST: "ON"
7. Chamber Vacuum: 25 - 27 inches Hg.
8. Record chamber vacuum reading in check sheet
9. STAT Switch: Press repeatedly to display and verify the following:

a. F Scale
b. NO Range - Record on check sheet
c. NO_y Range - Record on check sheet
d. Troubleshooting Parameters:
CL: Cooler Temperature (≈ -10°)
CT: Converter Temperature (≈ 350°)

RC: Reaction Chamber (≈ 49.5°)
B1: NO Zero =
B3: NO_y Zero =
SF: NO Span Factor =
BF: NO_y Span Factor =
CE: Converter Efficiency (≈99.7%)
NR: Number Register - Ignore
O: Offset - Leave at 0.0
DIP: Dip Switch. 2, 4, 6, and 8 "ON"
P: Software Version Number - Record this in equipment log during calibrations.
PT: Pressure and Temperature. Reads "ON"
°C: Temperature inside unit. Should be <40°C.
FSCALE: End of Troubleshooting mode.

9. Z/FS Button: Pressing Z/FS displays a 0 first, then -.23 volts. The display and all of the analog outputs then scroll up and can be stopped at any displayed voltage so that NO/NO_y monitor readings and DAS readings can be cross checked. To stop the displayed voltage, press the Z/FS switch a second time. Verify agreement at three points: low, middle, and high.

11. RUN Button: Press to activate. This is the normal operating mode as well as the instrument default mode. All diagnostics are canceled and the instrument is placed in automatic sampling mode. Display shows NO, Pressure, or NO_y as chosen by the DISP button.

12. DISP Button: Press to change displayed sample values.

a. NO concentration is indicated by a number "1" followed by the current concentration. Record this value in instrument column of check sheet
b. NO2 is indicated by the value following number "2". Record this value in instrument column of check sheet
c. NO_y concentration follows number "3". Record this value in instrument column of check sheet
d. Record Channel 8 (NO) DAS value in the DAS column of check sheet
e. Record Channel 9 (NO_y) DAS value in the DAS column of check sheet

8. NO/NO_w MONITOR (TECO Model 42S):

A. Same as for NO_y monitor listed in #7 above.

9. 28 VDC SYSTEM:

A.	Recheck both invertors	"OFF"
B.	Aircraft Master Switch:	Turn "ON"
C.	STI Power Switch:	Turn "ON"

10. AIRBORNE INSTRUMENT PACKAGE (AIP):

A. AIP Power: BREAKER SWITCH "ON"
AIP light should now be on.

B. Low Calibration Position:

1. Set all switches to low calibration position (FULL COUNTERCLOCKWISE)
2. Observe Channels 1, 4, and 19 on the DAS monitor for the following readings:

a. Channel 1 reads ~626
c. Channel 4 reads ~030
d. Channel 19 reads ~050

C. High Calibration Position

1. Set all switches to high calibration position (ONE POSITION CLOCKWISE)
2. Observe Channels 1, 4, and 19 on the DAS monitor for the following readings:

a. Channel 1 reads ~750
c. Channel 4 reads ~217
d. Channel 19 reads ~450

D. Operate Position

1. Set all switches to operate position (FULL CLOCKWISE)
2. Record values for Channels 1, 4, and 19 on the check sheet

E. Record aircraft thermometer (OAT) reading on check sheet
F. Record Channel 01 DAS reading in DAS column on check sheet

11. VOC PUMP

A. Pull out breaker on rack (above inverter switches)
B. Turn on both pump switches near pumps (under ozone monitor)
C. Test that both pumps are running/producing flow from the can-fill tee.
D. Turn off both pumps
E. Pull out VOC pump breaker

12. 28 VDC SYSTEM:

A. STI Power Switch: Turn "OFF"
B. Aircraft Master Switch: Turn "OFF"

13. EVENT CODE SWITCH:

A. Run through all the numbers on the Event Code Switch to confirm that DAS Event Code Channel reading follows the switch

14. LAST MINUTE DETAILS:

A. Confirm that all cables, connectors, and sample lines are securely connected to instruments
B. Be sure the O_3, sampling line is securely connected to glass manifolds
C. NO/NO_y NO/NO_w instruments are securely connected to respective intake manifolds
C. Verify that all junction box sockets have signal connectors or shorting plugs attached
D. Be sure the headsets are aboard, connected and operational
E. Be sure sufficient Flight Record Sheets are available for flight notes
F. Load required canisters, bags, tags, and crescent wrench
G Notify appropriate ground personnel of expected takeoff time and proposed flight route
H. Remove plug from hydrocarbon and carbonyl inlet lines

III. POWER TRANSFER

1. **ENGINES:** Start

2. **WITH BOTH ENGINES RUNNING:**

   A. STI Power Switch: Turn "ON"
   B. Invertor 1: Turn "ON"
   C. Invertor 2: Turn "ON"
   D. ROG pump breaker Push "IN"
   D. Intercom: Turn "ON"
   E. Loran: Reset to 29.92

3. **SHORE POWER:** Disconnect

4. **DOOR:** Close and Latch

5. **EMERGENCY EXIT:** Check that door is *SECURE and CLEAR*

6. **DATA ACQUISITION SYSTEM:**

   A. Monitor reboot (if required)
   B. Press SHIFT-F1 to begin recording data
   C. Record start time on check sheet
   D. Check that system is recording data (records counting up)

7. **EVENT SWITCH:** Set to Code 1, press button (light on)

8. **DAS:** Confirm that system is recording data

9. **PRINTER:** Confirm that it is printing data

10. **SEAT BELTS:** Securely fastened

IV. TAXI / RUNUP

1. **EVENT SWITCH:** Turn to "4"

2. **SAMPLE MONITORS:** Switch to **ZERO** as follows:

   A. Ozone: use zero mode switch
   B. NO/NO_y and NO/NO_w- Confirm the following:

      1. Ozonator Switch: "ON"
      2. PMT: "OFF"
      3. Mode: "RUN"

3. **OZONE:** Record zero value on Flight Record Sheet
4. **NO/NO1:** Record zero values on Flight Record Sheet
5. **NO_y/NO_w:** Record zero values on Flight Record Sheet
6. **ALTITUDE:** Record runup area LORAN indicated pressure altitude on Flight Record Sheet.

7. **EVENT SWITCH:** Turn "OFF"

8. **SAMPLE MONITORS:** Switch to **SAMPLE** as follows:

   A. Ozone: sample mode
   B. NO/NO_y and NO/NO_w - Confirm the following:

      1. Ozonator Switch: "ON"
      2. PMT: "ON"
      3. Mode: "RUN"

9. **DATA ACQUISITION SYSTEM:** Confirm it is recording data

10. **PRINTER:** Confirm it is printing data

12. **ROG PUMP:** Check that "OFF"

STOP AND THINK !

HYDROCARBON CANISTERS: Are sufficient canisters aboard?

DISKETTES: Are **extra** disks aboard?

SAMPLE INLETS: Are they all unplugged?

CRESCENT WRENCHES: You will probably need **two**.

NOTIFICATIONS: Have you informed the appropriate ground personnel of expected takeoff and landing times?

SURVIVAL GEAR: Well?

V. SAMPLING

1. EMERGENCY PROCEDURES:

A. C_2H_4: Turn both valves "OFF"
B. STI Power Switch: Turn "OFF" (except C_2H_4 leak)
C. Invertor #1: Turn "OFF"
D. Invertor #2: Turn "OFF"
E. AIP Breaker: Pull "OUT"
F. All other breakers on racks: Pull "OUT"

2. EVENT CODES:

A.	Non-pass:	Code 0 EVENT "ON"
B.	Vertical Spirals	Code 1 EVENT "ON"
C.	Dolphin Patterns	Code 2 EVENT "ON"
D.	Horizontal Traverses	Code 3 EVENT "ON"
E.	Zeroing	Code 4 EVENT "ON"
F.	Horizontal Orbits	Code 5 EVENT "ON"
G.	Other	Code 6-9 EVENT "ON"

3. FLIGHT RECORD SHEETS:

Complete as required for each pass or sampling event

4. SYSTEMS CHECK SHEETS:

Complete at least one in-flight check

5. DAS POWER LOSS PROCEDURES:

A. Confirm DAS has rebooted and is writing data to the hard drive (red light on DAS case flashing) and to the ZIP drive (amber light on ZIP drive flashing).

6. DAS EMERGENCY OPERATION (Only if DAS will not boot by itself):

A. Push emergency disk already in drive a: all the way in.
B. Press Reset button on front of computer (reboot)
C. Confirm DAS booted from, and is writing data to drive a:
D. After flight, remove and label disk from drive a:

7. GRAB SAMPLES:

A. Hydrocarbon (ROG) Canister Samples:

1. Samples will be collected according to sampling instruction in flight manual (differing for each sampling route).
2. Connect canister to purge "TEE" 3-5 minutes before it is time to begin the sample collection.
3. Turn on ROG pumps 2-3 minutes prior to the start of ROG sampling.
3. Document required information on manila tag and securely connect tag to canister. Record required information on Flight Record Sheet

B. Carbonyl Bag Samples

1. Samples will be collected at the same times and locations as ROG samples (as per flight plans in flight manual).
2. Connect bag to carbonyl line with bag valve "OFF"
3. Open bag valve and fill bag
4. Close bag valve and disconnect sample line from bag
5. Document required information on manila tag and securely connect tag to canister. Record required information on Flight Record Sheet

8. GENERAL SAMPLING GUIDELINES:

A. All sampling is done on a best effort, weather and safety permitting basis.

B. Maintenance problems should be handled immediately

C. Ethylene (C_2H_4) is flammable, explosive, and heavier than air. **ALWAYS** leak check very carefully when changing ethylene bottles. If an ethylene odor is detected, secure the main bottle valve immediately. Ethylene pressure should decrease approximately 100 psi during a four hour flight.

VI. POST FLIGHT

1. **HYDROCARBON PUMP:** ROG pump breaker pull "OUT"
2. **LANDING TIME:** Record landing time on check sheet
3. **EVENT SWITCH:** Turn to "4"
4. **SAMPLE MONITORS:** Switch to **ZERO** as follows:

   A. Ozone: select the zero mode
   B. NO/NO_y and NO/NO_w- Confirm the following:

      1. Ozonator Switch: "ON"
      2. PMT: "OFF"
      3. Mode: "RUN"

5. **OZONE, NO/NO_x, NO/NO_w:** Record zero values.
6. **EVENT SWITCH:** Turn to "0"
7. **OZONE, NO/NO_x, NO/NO_w:** Place in sample mode.
8. **DATA ACQUISITION SYSTEM:** Press SHIFT-F1 to stop recording
9. **DAS STOP TIME:** Record system stop time on check sheet
10. **C_2H_4 BOTTLE:** Turn both valves "OFF"
11. **SHORE POWER:** Connect to socket in back of airplane
12. **INVERTOR #1:** Turn "OFF"
13. **INVERTOR #2:** Turn "OFF"
14. **STI POWER SWITCH:** Switch "OFF"
15. **ENGINES:** Shut down
16. **DEW POINT:** Turn "OFF"

17. HYDROCARBON LINE: "CAP"

18. DAS PRINTER: Remove and document printout

19. DOCUMENT THE FOLLOWING

A. All hydrocarbon canisters
B. All carbonyl bags
C. Data disks and copies
D. Printer output

20. NOTIFICATION: Notify appropriate ground personnel of landing

21. DEW POINT SENSOR: Clean as required

22. FUEL: Fuel and service aircraft

APPENDIX B

SUMMARY OF MORNING AND AFTERNOON ALOFT LAYERS

SUMMARY OF MORNING ALOFT LAYERS

AM flight summary

Spiral Location	CMA - Camarillo Airport (Elevation 23 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-1 4:37-4:42 PST	5	0	76	71	550	40	325	76	550	64	800
4 8/5/97 AM	Pass 4-1 4:31-4:36 PST	2	0	48	46	400	48	400				
6 8/6/97 AM	Pass 6-1 4:38-4:44 PST	4	25				52	825				
8 8/7/97 AM	Pass 8-1 8:21-8:33 PST	14	0	64	50	375	64	375	100	1075	**78**	1450
	Pass 8-12 10:36-10:46 PST	42	0	84	42	650	88	375	84	650	**98**	1100
9 8/22/97 AM	Pass 9-1 4:45-4:54 PST	2	0	28	26	425	28	425	56	950		
11 8/23/97 AM	Pass 11-1 4:29-4:35 PST	4	0	56	52	650	56	650	62	925		
14 9/4/97 AM	Pass 14-1 4:57-5:03 PST	2	0	44	42	375	44	375	60	900		
16 9/5/97 AM	Pass 16-1 4:59-5:05 PST	2	0	52	50	700	44	250	52	700		
18 9/6/97 AM	Pass 18-1 4:45-4:53 PST	14	0	66	52	400	66	400	40	900		
20 9/28/97 late AM	Pass 20-1 8:49-8:55 PST	34	0	44	10	325	44	325				
22 9/29/97 AM	Pass 22-1 4:43-4:48 PST	not enough data										
24 10/3/97 AM	Pass 24-1 4:43-4:49 PST	2	0	56	54	474	28	225	56	475	44	900
26 10/4/97 AM	Pass 26-1 4:33-4:39 PST	6	0				82	850				
		11		56	45	484						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	MAL - Offshore Malibu (Elevation 0 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM												
4 8/5/97 AM	Pass 4-3 4:52-5:02 PST	18	50	60	42	675	60	675	40	1175		
6 8/6/97 AM	Pass 6-3 4:58-5:11 PST	30	20	48	18	50	48	50	36	375	66	1425
8 8/7/97 AM	Pass 8-2 8:44-8:56 PST	22	25	54	32	475	54	475	**126**	1075	98	1400
9 8/22/97 AM												
11 8/23/97 AM	Pass 11-3 4:49-4:59 PST	16	25	72	56	625	72	625	62	1450 P		
14 9/4/97 AM												
16 9/5/97 AM												
18 9/6/97 AM	Pass 18-3 5:08-5:13 PST	18	325	30	12	600	30	600	72	875	48	1400 P
20 9/28/97 late AM												
22 9/29/97 AM	Pass 22-3 5:04-5:17 PST	30	50	88	58	525	40	100	56	325	88	525
24 10/3/97 AM												
26 10/4/97 AM	Pass 26-3 4:53-5:06 PST	42	50	86	44	625	64	425	86	625	72	1100
		25		63	37	511						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	VNY - Van Nuys Airport (Elevation 244 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-3 4:57-5:06 PST	4	250	64	60	700	28	300	64	700	58	850
4 8/5/97 AM	Pass 4-5 5:13-5:22 PST	1	240	56	55	550	48	450	56	550	**80**	1490
6 8/6/97 AM	Pass 6-5 5:20-5:30 PST	3	240	44	41	575	44	575	68	1475 P		
8 8/7/97 AM	Pass 8-4 9:06-9:14 PST	34	250	50	16	750	50	750	**128**	1150	**108**	1500
9 8/22/97 AM	Pass 9-3 5:10-5:18 PST	2	225	58	56	825	12	500	58	825	58	1500
11 8/23/97 AM	Pass 11-5 5:12-5:25 PST	50	600				88	750	60	2250		
14 9/4/97 AM	Pass 14-3 5:19-5:27 PST	6	225	78	72	875	78	875	56	1250		
16 9/5/97 AM	Pass 16-3 5:22-5:32 PST	6	225	56	50	650	56	650	92	1075	68	1525 P
18 9/6/97 AM	Pass 18-5 5:24-5:34 PST	2	200	80	78	825	36	600	80	825	42	1400
20 9/28/97 late AM	Pass 20-3 9:08-9:16 PST	40	225	46	6	475	46	475				
22 9/29/97 AM	Pass 22-5 5:28-5:37 PST	2	225	82	80	600	30	325	82	600	70	700
24 10/3/97 AM	Pass 24-3 5:02-5:10 PST	1	200	38	37	500	38	500				
26 10/4/97 AM	Pass 26-5 5:17-5:26 PST	6	225	64	58	475	64	475	64	875	66	1275
		9		60	51	650						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	SIM - Simi Valley (Elevation 122 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
2 8/4/97 AM									
4 8/5/97 AM									
6 8/6/97 AM									
8 8/7/97 AM	Pass 8-6 9:24-9:34 PST	42	400	92	1150	**100**	1475		
9 8/22/97 AM									
11 8/23/97 AM									
14 9/4/97 AM									
16 9/5/97 AM									
18 9/6/97 AM									
20 9/28/97 late AM									
22 9/29/97 AM									
24 10/3/97 AM									
26 10/4/97 AM									

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	SZP - Santa Paula Airport (Elevation 75 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM												
4 8/5/97 AM												
6 8/6/97 AM												
8 8/7/97 AM	Pass 8-8 9:40-9:51 PST	24	75	78	54	425	78	425	**124**	1225	**74**	1500
9 8/22/97 AM												
11 8/23/97 AM												
14 9/4/97 AM												
16 9/5/97 AM												
18 9/6/97 AM												
20 9/28/97 late AM												
22 9/29/97 AM												
24 10/3/97 AM												
26 10/4/97 AM												

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	SBA - Santa Barbara Airport (Elevation 3 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM												
4 8/5/97 AM												
6 8/6/97 AM												
8 8/7/97 AM	Pass 8-10 10:10-10:17 PST	38	0	128	90	500	128	500	118	750	62	1050
9 8/22/97 AM												
11 8/23/97 AM												
14 9/4/97 AM												
16 9/5/97 AM												
18 9/6/97 AM												
20 9/28/97 late AM												
22 9/29/97 AM												
24 10/3/97 AM												
26 10/4/97 AM												

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	EMT - El Monte Airport (Elevation 90 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM												
4 8/5/97 AM	Pass 4-7 5:35-5:48 PST	1	100	67	66	525	58	425	67	525	**120**	1350
6 8/6/97 AM	Pass 6-7 5:46-5:57 PST	36	200	60	24	625	44	350	60	625		
8 8/7/97 AM												
9 8/22/97 AM												
11 8/23/97 AM	Pass 11-7 5:37-5:46 PST	6	100	68	62	800	14	150	68	800	**96**	1200
14 9/4/97 AM												
16 9/5/97 AM												
18 9/6/97 AM	Pass 18-7 5:47-5:55 PST	1	75	78	77	825	12	475	34	625	78	825
20 9/28/97 late AM	Pass 20-5 9:30-9:40 PST	64	100	88	24	275	88	275	68	650	52	700
22 9/29/97 AM	Pass 22-7 5:51-6:03 PST	0	100	68	68	825	58	400	90	600	68	825
24 10/3/97 AM												
26 10/4/97 AM	Pass 26-7 5:40-5:50 PST	8	100	68	60	850	14	350	68	850		
		17		71	54	675						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	AZU - Azusa (Elevation 244 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2^{nd} Aloft O3 (ppb)	Altitude (m)	3^{rd} Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
2 8/4/97 AM									
4 8/5/97 AM	Pass 4-9 5:54-6:04 PST	70	600	70	700	86	975	**84**	1275
6 8/6/97 AM	Pass 6-9 6:05-6:16 PST	50	600	66	1350				
8 8/7/97 AM									
9 8/22/97 AM									
11 8/23/97 AM	Pass 11-9 5:52-6:01 PST	50	650	60	750	**94**	1200	**90**	1350
14 9/4/97 AM									
16 9/5/97 AM									
18 9/6/97 AM	Pass 18-9 6:00-6:13 PST	38	750	48	1150	48	1975		
20 9/28/97 late AM									
22 9/29/97 AM	Pass 22-9 6:09-6:19 PST	54	600	70	850	62	950	**76**	1850
24 10/3/97 AM									
26 10/4/97 AM	Pass 26-9 5:57-6:08 PST	46	625	68	1075	66	1650		

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	SGR - San Gabriel Reservoir (Elevation 610 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2^{nd}Aloft O3 (ppb)	Altitude (m)	3^{rd}Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
2 8/4/97 AM									
4 8/5/97 AM	Pass 4-11 6:08-6:16 PST	84	950	100	1025	**106**	1200	68	1900
6 8/6/97 AM	Pass 6-11 6:20-6:29 PST	52	725	62	950				
8 8/7/97 AM									
9 8/22/97 AM									
11 8/23/97 AM	Pass 11-11 6:04-6:13 PST	44	750	64	1100	**82**	1300	50	1750 P
14 9/4/97 AM									
16 9/5/97 AM									
18 9/6/97 AM	Pass 18-11 6:16-6:24 PST	2	275	60	800	46	1050		
20 9/28/97 late AM									
22 9/29/97 AM	Pass 22-11 6:22-6:29 PST	62	1000	70	1125	**84**	2000		
24 10/3/97 AM									
26 10/4/97 AM	Pass 26-11 6:12-6:20 PST	52	750	64	1150	68	1850		

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	ONT - Ontario Airport (Elevation 287 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM												
4 8/5/97 AM	Pass 4-14 6:27-6:37 PST	0	275	108	108	1050	78	750	108	1050	115	1250
6 8/6/97 AM	Pass 6-14 6:43-6:58 PST	4	300	62	58	975	62	975	68	1325		
8 8/7/97 AM												
9 8/22/97 AM												
11 8/23/97 AM	Pass 11-14 6:23-6:33 PST	2	275	62	60	775	62	775	**94**	1325		
14 9/4/97 AM												
16 9/5/97 AM												
18 9/6/97 AM	Pass 18-14 6:35-6:43 PST	6	425	52	46	775	52	775	38	1300		
20 9/28/97 late AM	Pass 20-7 9:56-10:03 PST	62	300				50	375				
22 9/29/97 AM	Pass 22-14 6:41-6:54 PST	1	275	74	73	750	50	500	74	750	52	1525
24 10/3/97 AM												
26 10/4/97 AM	Pass 26-14 6:35-6:44 PST	6	300	68	62	925	24	350	28	600	68	925
		3		71	68	875						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	L70 - Agua Dulce Airport (Elevation 811 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-5 5:19-5:24 PST	42	750	52	10	1025	48	800	52	1025		
4 8/5/97 AM												
6 8/6/97 AM												
8 8/7/97 AM												
9 8/22/97 AM	Pass 9-5 5:29-5:33 PST	36	750	54	18	875	54	875				
11 8/23/97 AM												
14 9/4/97 AM	Pass 14-5 5:42-5:47 PST	44	750	76	32	1425	68	1300	76	1425		
16 9/5/97 AM	Pass 16-5 5:46-5:51 PST	66	750	80	14	900	80	900				
18 9/6/97 AM												
20 9/28/97 late AM												
22 9/29/97 AM												
24 10/3/97 AM	Pass 24-5 5:26-5:31 PST	30	775	52	22	1450	46	1275	52	1450		
26 10/4/97 AM												
		44		63	19	1135						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	L00 - Rosamond Airport (Elevation 736 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-7 5:38-5:47 PST	50	675	70	20	900	70	900	50	1900		
4 8/5/97 AM												
6 8/6/97 AM												
8 8/7/97 AM												
9 8/22/97 AM	Pass 9-7 5:47-5:58 PST	48	700	60	12	875	60	875				
11 8/23/97 AM												
14 9/4/97 AM	Pass 14-7 6:01-6:12 PST	12	675	48	36	875	48	875	68	2150		
16 9/5/97 AM	Pass 16-7 6:06-6:17 PST	44	700	72	28	850	72	850	78	1650		
18 9/6/97 AM												
20 9/28/97 late AM												
22 9/29/97 AM												
24 10/3/97 AM	Pass 24-7 5:47-5:59 PST	30	700	44	14	1250	44	1250				
26 10/4/97 AM												
		37		59	22	950						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	HES - Hesperia Profiler Site (Elevation 975 m)									
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date										
2 8/4/97 AM	Pass 2-9 6:14-6:24 PST	62	1080	64	62	1625	64	1850	64	2275 P
4 8/5/97 AM										
6 8/6/97 AM										
8 8/7/97 AM										
9 8/22/97 AM	Pass 9-9 6:22-6:32 PST	40	1100	42	42	1150	36	2175		
11 8/23/97 AM										
14 9/4/97 AM	Pass 14-9 6:43-6:53 PST	34	1100	48	48	1375	68	2075		
16 9/5/97 AM	Pass 16-9 6:46-6:54 PST	54	1125	62	62	1475	42	2275		
18 9/6/97 AM										
20 9/28/97 late AM										
22 9/29/97 AM										
24 10/3/97 AM	Pass 24-9 6:27-6:36 PST	24	1100	50	50	1500				
26 10/4/97 AM										

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	L22 - Yucca Valley Airport (Elevation 983 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-12 7:01-7:11 PST	62	925	76	14	1425	76	1425	76	2150	76	2275
4 8/5/97 AM												
6 8/6/97 AM												
8 8/7/97 AM												
9 8/22/97 AM	Pass 9-12 7:06-7:15 PST	22	925	50	28	1475	50	1475				
11 8/23/97 AM												
14 9/4/97 AM	Pass 14-12 7:31-7:42 PST	44	925	52	8	1450	52	1450				
16 9/5/97 AM	Pass 16-12 7:34-7:43 PST	52	925	60	8	1150	60	1150	48	2100		
18 9/6/97 AM												
20 9/28/97 late AM												
22 9/29/97 AM												
24 10/3/97 AM	Pass 24-12 7:15-7:26 PST	22	950	38	16	1100	38	1100				
26 10/4/97 AM												
		40		55	15	1320						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	BNG - Banning Airport (Elevation 676 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-14 7:25-7:39 PST	62	620	94	32	1500	**94**	1500	**72**	2300		
4 8/5/97 AM												
6 8/6/97 AM												
8 8/7/97 AM												
9 8/22/97 AM	Pass 9-14 7:29-7:41 PST	22	650	52	30	700	52	700	46	1125		
11 8/23/97 AM												
14 9/4/97 AM	Pass 14-14 7:56-8:08 PST	42	650	50	8	1050	46	675	50	1050		
16 9/5/97 AM	Pass 16-14 8:00-8:12 PST	54	675	64	10	825	64	825	50	1250		
18 9/6/97 AM												
20 9/28/97 late AM												
22 9/29/97 AM												
24 10/3/97 AM	Pass 24-14 7:38-7:51 PST	26	650	42	16	1350	42	1350	64	2300		
26 10/4/97 AM												
		41		60	19	1085						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	L67 - Rialto Airport (Elevation 443 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2[nd]Aloft O3 (ppb)	Altitude (m)	3[rd]Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-16 7:54-8:00 PST	42	430	76	34	975	66	650	76	975		
4 8/5/97 AM	Pass 4-16 6:46-6:53 PST	28	425	72	44	1100	64	625	72	1100	84	1450
6 8/6/97 AM	Pass 6-16 7:08-7:17 PST	26	425	56	30	800	56	800	68	1525		
8 8/7/97 AM												
9 8/22/97 AM	Pass 9-16 7:54-8:00 PST	8	425	52	44	775	34	650	52	775	50	1025
11 8/23/97 AM	Pass 11-16 6:43-6:58 PST	30	425	64	34	850	64	850	48	2150		
14 9/4/97 AM	Pass 14-16 8:22-8:28 PST	44	425	56	12	750	56	750				
16 9/5/97 AM	Pass 16-16 8:29-8:36 PST	42	450	72	30	825	66	700	72	825		
18 9/6/97 AM	Pass 18-16 6:51-6:59 PST	6	425	58	52	775	52	775	38	1300		
20 9/28/97 late AM	Pass 20-9 10:12-10:20 PST	46	425									
22 9/29/97 AM	Pass 22-16 7:03-7:11 PST	8	425	64	56	975	52	700	64	975	56	1525
24 10/3/97 AM	Pass 24-16 8:06-8:16 PST	14	425	48	34	1175	30	800	48	1175		
26 10/4/97 AM	Pass 26-16 6:52-7:01 PST	12	425	76	64	825	76	825	64	1100		
		24		63	39	893						

Bold entries are detached layers above or at top of the boundary layer.

AM flight summary

Spiral Location	RAL - Riverside Airport (249 m)											
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	max<800 m agl (m)	Max minus bottom (ppb)	Max ozone alt (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date												
2 8/4/97 AM	Pass 2-18 8:07-8:17 PST	32	250	86	54	725	96	475	86	725	74	1100
4 8/5/97 AM	Pass 4-18 7:01-7:12 PST	6	225	66	60	700	44	500	66	700		
6 8/6/97 AM	Pass 6-18 7:26-7:36 PST	14	240	62	48	925	62	925				
8 8/7/97 AM												
9 8/22/97 AM	Pass 9-18 8:07-8:16 PST	6	250	54	48	925	44	600	54	925		
11 8/23/97 AM	Pass 11-18 7:05-7:14 PST	12	250	72	60	975	64	650	72	975	88	1325
14 9/4/97 AM	Pass 14-18 8:35-8:43 PST	36	275	53	17	850	52	475	53	850	64	1450
16 9/5/97 AM	Pass 16-18 8:44-8:53 PST	42	225	82	40	650	56	350	82	650	56	1025
18 9/6/97 AM	Pass 18-18 7:06-7:14 PST	10	200	44	34	775	44	775	34	1325		
20 9/28/97 late AM	Pass 20-11 10:26-10:35 PST	52	250									
22 9/29/97 AM	Pass 22-18 7:18-7:28 PST	4	250	54	50	525	54	525	56	1100	34	1400
24 10/3/97 AM	Pass 24-18 8:22-8:30 PST	26	250	34	8	800	34	800	44	1175	56	1550
26 10/4/97 AM	Pass 26-18 7:07-7:14 PST	42	725				72	825	76	950	88	1175
		19		61	42	785						

Bold entries are detached layers above or at top of the boundary layer.

SUMMARY OF AFTERNOON ALOFT LAYERS

PM flight summary

Spiral Location	RAL - Riverside Airport (249 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM	Pass 3-1 14:03-14:12 PST	84	225	82	400	**98**	975	60	1250
5 8/5/97 PM	Pass 5-1 4:31-4:36 PST	160	225	164	275	166	550	70	1150
7 8/6/97 PM	Pass 7-1 12:58-13:09 PST	124	225	130	350	136	650	122	1250
10 8/22/97 PM	Pass 10-1 14:07-14:17 PST	64	250	76	450	58	950	**60**	1300
12 8/23/97 PM	Pass 12-1 13:08-13:15 PST	114	225	124	700	126	900	**70**	1575
15 9/4/97 PM	Pass 15-1 14:07-14:17 PST	116	225	122	275	120	1000	116	1300
17 9/5/97 PM	Pass 17-1 13:57-14:07 PST	110	200	112	600	118	775	140	1250
19 9/6/97 PM	Pass 19-1 12:56-13:06 PST	104	175	78	1525				
21 9/28/97 PM	Pass 21-1 13:07-13:17 PST	52	250	60	675				
23 9/29/97 PM	Pass 23-1 12:57-13:06 PST	94	225	104	625	108	825	92	1200
25 10/3/97 PM 4:23 - 4:40	Pass 25-1 13:56-14:06 PST	64	250	76	900				
27 10/4/97 PM									

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	L67 - Rialto Airport (Elevation 443 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM	Pass 3-3 14:18-14:32 PST	126	425	136	825	126	1050	**85**	2200
5 8/5/97 PM	Pass 5-3 13:27-13:38 PST	140	400	142	725	130	900	100	1200
7 8/6/97 PM	Pass 7-3 13:19-13:30 PST	154	450	158	725	144	1075		
10 8/22/97 PM	Pass 10-3 14:21-14:30 PST	78	425	82	475	64	850	40	975
12 8/23/97 PM	Pass 12-3 13:21-13:36 PST	106	400	112	650	82	1100	60	1925
15 9/4/97 PM	Pass 15-3 14:24-14:36 PST	100	425	108	475	96	1750		
17 9/5/97 PM	Pass 17-3 14:14-14:26 PST	92	425	98	750	98	1650	102	1900
19 9/6/97 PM	Pass 19-3 13:13-13:26 PST	92	450	100	750	84	1500	36	1650
21 9/28/97 PM	Pass 21-3 13:24-13:31 PST	48	425	56	1450				
23 9/29/97 PM	Pass 23-3 13:12-13:26 PST	102	400	102	700	88	950	56	1175
25 10/3/97 PM 4:23 - 4:40	Pass 25-3 14:15-14:26 PST	68	400	78	1150	76	1300	68	1425
27 10/4/97 PM	Pass 27-1 14:01-14:15 PST	100	425	106	900	76	1150	**92**	1900

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	BNG - Banning Airport (Elevation 676 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM									
5 8/5/97 PM	Pass 5-5 13:57-14:09 PST	64	625						
7 8/6/97 PM	Pass 7-5 13:49-14:00 PST	80	650	80	775	68	1675		
10 8/22/97 PM									
12 8/23/97 PM	Pass 12-5 13:52-14:06 PST	72	625	74	2250 P				
15 9/4/97 PM									
17 9/5/97 PM									
19 9/6/97 PM	Pass 19-5 13:44-13:54 PST	54	625						
21 9/28/97 PM									
23 9/29/97 PM									
25 10/3/97 PM 4:23 - 4:40									
27 10/4/97 PM									

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	L22 - Yucca Valley Airport (Elevation 983 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM									
5 8/5/97 PM	Pass 5-7 14:23-14:34 PST	60	900						
7 8/6/97 PM	Pass 7-7 14:16-14:24 PST	50	950						
10 8/22/97 PM									
12 8/23/97 PM	Pass 12-7 14:19-14:27 PST	68	950	74	1100				
15 9/4/97 PM									
17 9/5/97 PM									
19 9/6/97 PM	Pass 19-7 14:09-14:18 PST	64	975						
21 9/28/97 PM									
23 9/29/97 PM									
25 10/3/97 PM 4:23 - 4:40									
27 10/4/97 PM									

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	HES - Hesperia Profiler Site (Elevation 975 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM									
5 8/5/97 PM	Pass 5-11 15:15-15:25 PST	66	1150						
7 8/6/97 PM	Pass 7-11 15:04-15:12 PST	98	1025	108	1125	106	1325	**96**	1875
10 8/22/97 PM									
12 8/23/97 PM	Pass 12-11 15:08-15:15 PST	62	1125	62	1250	**64**	1550	72	1900
15 9/4/97 PM									
17 9/5/97 PM									
19 9/6/97 PM	Pass 19-11 14:59-15:07 PST	42	1175						
21 9/28/97 PM									
23 9/29/97 PM									
25 10/3/97 PM 4:23 - 4:40									
27 10/4/97 PM									

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	OCL6 - Bohunk's Airport (Elevation 735 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM									
5 8/5/97 PM	Pass 5-14 15:53-16:06 PST	76	700						
7 8/6/97 PM	Pass 7-14 15:44-15:55 PST	140	700	140	950	128	1250	100	1700
10 8/22/97 PM									
12 8/23/97 PM	Pass 12-14 15:43-15:54 PST	98	725	106	975	96	1300	**44**	2100
15 9/4/97 PM									
17 9/5/97 PM									
19 9/6/97 PM	Pass 19-14 15:38-15:48 PST	76	750	82	900	76	1200	50	1750
21 9/28/97 PM									
23 9/29/97 PM									
25 10/3/97 PM 4:23 - 4:40									
27 10/4/97 PM									

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	ONT - Ontario Airport (Elevation 287 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM	Pass 3-5 14:39-14:48 PST	108	275	110	325	106	650	**60**	1500
5 8/5/97 PM									
7 8/6/97 PM									
10 8/22/97 PM	Pass 10-5 14:36-14:43 PST	102	275	102	400	94	575	1050	
12 8/23/97 PM									
15 9/4/97 PM	Pass 15-5 14:43-14:51 PST	108	300	114	350				
17 9/5/97 PM	Pass 17-5 14:33-14:42 PST	90	300	124	650	104	1100	80	1400
19 9/6/97 PM									
21 9/28/97 PM	**Pass 21-5** 13:40-13:49 PST	112	300	146	525	128	1250	110	1400
23 9/29/97 PM	Pass 23-5 13:33-13:42 PST	96	250	94	600	76	950	64	1125
25 10/3/97 PM 4:23 - 4:40	Pass 25-5 14:33-14:40 PST	72	275	68	1200	68	1300		
27 10/4/97 PM	Pass 27-3 14:20-14:31 PST	116	300	102	700	80	1000	90	1250

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	AZU - Azusa (Elevation 244 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM									
5 8/5/97 PM									
7 8/6/97 PM									
10 8/22/97 PM									
12 8/23/97 PM									
15 9/4/97 PM									
17 9/5/97 PM									
19 9/6/97 PM									
21 9/28/97 PM	**Pass 21-7** 13:57-14:07 PST	160	750	168	875	**146**	1100	64	1300
23 9/29/97 PM	Pass 23-7 13:52-14:04 PST	102	550	76	900	66	1600	**76**	2150
25 10/3/97 PM 4:23 - 4:40									
27 10/4/97 PM									

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	EMT - El Monte Airport (Elevation 90 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM	Pass 3-7 15:00-15:11 PST	88	100	88	200	78	550	52	650
5 8/5/97 PM									
7 8/6/97 PM									
10 8/22/97 PM	Pass 10-7 14:55-15:03 PST	46	75	72	300	134	1250	46	1250
12 8/23/97 PM									
15 9/4/97 PM	Pass 15-7 15:04-15:12 PST	92	100	100	400	68	925	72	1250
17 9/5/97 PM	Pass 17-7 14:55-15:05 PST	60	100	56	750				
19 9/6/97 PM									
21 9/28/97 PM	Pass 21-9 14:16-14:25 PST	124	100	150	300	146	450	96	675
23 9/29/97 PM	Pass 23-9 14:10-14:20 PST	58	100	68	200	116	725	58	1000
25 10/3/97 PM 4:23 - 4:40	Pass 25-7 14:50-15:00 PST	58	75	86	775	70	1200		
27 10/4/97 PM	Pass 27-5 14:43-14:53 PST	80	250	120	750	72	1000	94	1300

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	VNY - Van Nuys Airport (Elevation 244 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM	Pass 3-9 15:26-15:34 PST	62	250	84	475	92	1225		
5 8/5/97 PM	Pass 5-16 16:22-16:29 PST	56	225	64	425	82	875	68	1450 P
7 8/6/97 PM	Pass 7-16 16:12-16:20 PST	72	250	96	550	118	725	106	1250
10 8/22/97 PM	Pass 10-9 15:16-15:27 PST	64	250	106	700	124	1250	**68**	2200
12 8/23/97 PM	Pass 12-16 16:11-16:23 PST	96	225	104	650	26	1425		
15 9/4/97 PM	Pass 15-9 15:27-15:42 PST	68	225	96	925	124	2050	130	2250
17 9/5/97 PM	Pass 17-9 15:23-15:31 PST	52	250	68	575				
19 9/6/97 PM	Pass 19-16 16:05-16:18 PST	40	250	74	500	40	1825		
21 9/28/97 PM	Pass 21-11 14:46-14:59 PST	60	250	84	1475				
23 9/29/97 PM	Pass 23-11 14:34-14:42 PST	102	225	128	625	132	725	128	1150
25 10/3/97 PM 4:23 - 4:40	Pass 25-9 15:15-15:27 PST	84	250	92	1000	76	1500	84	2175
27 10/4/97 PM	Pass 27-7 15:08-15:22 PST	74	250	88	450	82	950	82	1550

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	SIM - Simi Valley (Elevation 122 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM	Pass 3-11 15:45-15:54 PST	64	350	66	400	64	1175		
5 8/5/97 PM									
7 8/6/97 PM									
10 8/22/97 PM	Pass 10-11 15:38-15:44 PST	64	400	64	475	50	1475		
12 8/23/97 PM									
15 9/4/97 PM	Pass 15-11 15:53-16:01 PST	60	350	102	750				
17 9/5/97 PM	Pass 17-11 15:42-15:52 PST	52	300	56	650	72	775	52	1375
19 9/6/97 PM									
21 9/28/97 PM									
23 9/29/97 PM									
25 10/3/97 PM 4:23 - 4:40	Pass 25-11 15:36-15:44 PST	70	400	92	850	72	1200	74	1475
27 10/4/97 PM									

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	MAL - Offshore Malibu (Elevation 0 m)								
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)
Flight Number / Date									
3 8/4/97 PM									
5 8/5/97 PM									
7 8/6/97 PM									
10 8/22/97 PM									
12 8/23/97 PM									
15 9/4/97 PM									
17 9/5/97 PM									
19 9/6/97 PM									
21 9/28/97 PM	**Pass 21-13** 15:05-15:18 PST	56	50	184	150	84	450	52	725
23 9/29/97 PM	Pass 23-13 14:50-15:04 PST	52	50	128	300	96	475	102	700
25 10/3/97 PM 4:23 - 4:40									
27 10/4/97 PM	Pass 27-9 15:28-15:38 PST	48	50	74	550	76	750	88	1100

Bold entries are detached layers above or at top of the boundary layer.

PM flight summary

Spiral Location	CMA - Camarillo Airport (Elevation 23 m)										
Layer Measurement	Flight pass information	Bottom O3 (ppb)	Altitude (m)	Aloft O3 (ppb)	Altitude (m)	2nd Aloft O3 (ppb)	Altitude (m)	3rd Aloft O3 (ppb)	Altitude (m)		
Flight Number / Date											
3 8/4/97 PM	Pass 3-13 16:03-16:11 PST	44	0	46	50	98	275	48	675		
5 8/5/97 PM	Pass 5-18 16:46-16:54 PST	56	0	60	50	102	300	**70**	1200		
7 8/6/97 PM	Pass 7-18 16:38-16:47 PST	46	0	50	50	132	325	140	450	172	900
10 8/22/97 PM	Pass 10-13 15:55-16:09 PST	44	0	60	300	68	450	72	725	56	1050
12 8/23/97 PM	Pass 12-18 16:40-16:52 PST	40	0	84	675	30	1300				
15 9/4/97 PM	Pass 15-13 16:13-16:30 PST	44	0	80	425	88	850	88	1850		
17 9/5/97 PM	Pass 17-13 16:03-16:18 PST	46	0	92	325	**78**	825	44	1500		
19 9/6/97 PM	Pass 19-18 16:35-16:51 PST	46	0	62	350	46	575	48	100	54	1675
21 9/28/97 PM	Pass 21-15 15:34-15:43 PST	78	0	110	200	90	750				
23 9/29/97 PM	Pass 23-15 15:19-15:34 PST	36	0	112	200	112	350	78	600	60	1475
25 10/3/97 PM 4:23 - 4:40	Pass 25-13 15:55-16:09 PST	56	0	80	650	100	850	68	1300		
27 10/4/97 PM	Pass 27-11 15:57-16:14 PST	56	0	104	550	60	850	**80**	1950		

Bold entries are detached layers above or at top of the boundary layer.